

*Igor ĐURĐIĆ, Vladeta STEVOVIĆ, Vesna MILIĆ,  
Tanja JAKIŠIĆ, Branka GOVEDARICA,  
Milan JUGOVIĆ, Siniša BERJAN<sup>1</sup>*

## FORAGE PEA YIELD IN DIFFERENT AGROECOLOGICAL CONDITIONS

### SUMMARY

Since the production area of forage peas is begin to increase, the experiment was set up at two localities, Banja Luka and East Sarajevo. For experiment was used five domestic varieties Saša and NS Junior from Serbia. The experiment was carried out with three types of fertilization (without the use of mineral fertilizers, basic fertilization with NPK and basic fertilization by NPK + nitrogen addition). The variety Saša had the highest yield of green mass and hay. The application of basic fertilization had the influence on tested parameters, while the application of basic fertilizer in combination with topdressing had poorer results. Agro-ecological conditions had the influence on yield of hay, so greater results are achieved on experimental field East Sarajevo.

**Keywords:** forage peas, yield, hay, green mass, variety

### INTRODUCTION

Peas are usually used in the diet of humans and domestic animals, but it also playing an important role in fertilization as green fertilizer. According to Eric et al. (2007), peas are cultivated in the world at 7.621.928 ha, out of which 1.046.011 ha or 13.71 % is covered with forage pea. In our country pea is grown on small surfaces. Livestock peas can be used as green fodder, hay, silage, shade, for dehydration and if necessary green manure fertilizer (sideration). Pea's production is mainly focused to the production of grains, which represent concentrated animal feed. In our mountain-hilly production conditions, the production of hay is dominant, while silage production is less represented. Peas are sown mixed with cereals, mostly as early crops. Peas for the production of hay are little used, because it should be cutting in May, but May is a month with plenty of precipitation and it is difficult to dry a large mass of hay and that can affects the quality of hay which decreasing significantly. Early peas for the production of hay is cutting slightly later than the winter pea variety, when plants are in the stage of full flowering and the start of filling (Gatarić et al., 2014).

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<sup>1</sup>Igor Đurđić, Vesna Milić (corresponding author: vesnamlc@yahoo.co.uk), Tanja Jakišić, Branka Govedarica, Milan Jugović, Siniša Berjan, University of East Sarajevo, Faculty of Agriculture, Vuka Karadjica 30, BOSNIA AND HERZEGOVINA, Vladeta Stevović, Agronomic Faculty Čačak, University of Kragujevac, SERBIA

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The yield of green mass in pure crop per hectare is 25-35 t, and in the mixture with cereals up to 50 t ha<sup>-1</sup> (Mišković, 1986). In the research for the production of forage (Gatarić *et al.*, 2014), peas is fertilized with combined NPK fertilizers, with: 40-80 kg ha<sup>-1</sup> nitrogen, 80-100 kg ha<sup>-1</sup> potassium and 80-120 kg ha<sup>-1</sup> phosphorus. For the production of the early forage pea, it is recommended to fertilize with NPK (10:20:30) for lighter soil (Lončar *et al.*, 1989, cited by Rapčan *et al.*, 2004), and for the heavy soil with NPK (8:26:28), while Brkić (2002) recommended 40-150 kg ha<sup>-1</sup> N entering a quantity that will satisfy pea needs. For the yield of the early spring pea, amounts of rainfall in May and the first decade of June (Kovac, 1994; Rapčan *et al.*, 2006) are very important. Since early spring pea is grown from March to July in our agroecological conditions, the negative influence of high summer temperatures occurs during the development of pods (Duthion & Pigeaire, 1991). Temperatures above 26 °C in the stage immediately after flowering can significantly reduce the yield of grain due to decay of flowers (Popović *et al.*, 2002).

### MATERIAL AND METHODS

The experiment was set up in 2016 at the experimental field of the Agricultural Institute of Republic of Srpska in Banja Luka (altitude 160 meters) and the experimental field of the Faculty of Agriculture in East Sarajevo (altitude 550 m). The field experiment was set in a randomized block design with four replications. The sowing was done at 12.5 cm spacing and space of 8 cm in the main plot of 5 m<sup>2</sup>. Seed of two varieties of fodder peas was used for sowing: NS Junior and Saša. In the study of the influence of mineral nutrition on the yield of green pea mass (t ha<sup>-1</sup>) and yield of hay (t ha<sup>-1</sup>), together with the control variant, the basic fertilizer application of 350 kg ha<sup>-1</sup> N<sub>8</sub>P<sub>24</sub>K<sub>24</sub> and a variant with basic fertilization of 350 kg ha<sup>-1</sup> N<sub>8</sub>P<sub>24</sub>K<sub>24</sub> + yield with 27 kg ha<sup>-1</sup> (27% KAN used) were used. In Banja Luka, sowing was done on April 15 and harvest on July 15, while in East Sarajevo sowing took place on April 8, and harvest on July 18. At the floral stage, samples of the above ground mass of plants from a surface of 1 m<sup>2</sup> were taken from each repetition. After weighing, the mass of the samples was calculated on the quantity of above ground vegetative mass in t ha<sup>-1</sup>. Then the drying of the sample was performed to obtain an air dry weight. Then the sample was weighed and conversion was performed to obtain the yield of hay.

The obtained data were processed by the method of variance analysis (MANOVA) and tested by the LSD test (STATISTICA 7.1 for Windows (Stat Soft 2005)).

#### Agroecological conditions

The disposition of total monthly precipitation and average monthly air temperature for 2016 and perennial average for Banja Luka and Sarajevo is shown in Table 1. The temperature conditions for pea development were favorable. Average monthly air temperatures at both sites during the testing year were more than the perennial average; only in May 2016 the mean monthly temperature was somewhat lower than the perennial average. During the

vegetation period, precipitation oscillated from month to month. In 2016, in Banja Luka area, the extreme month was May with only 0.5 mm of precipitation. Uneven precipitation patterns affect the forage pea yield.

**Table 1.** Average monthly air temperatures (°C), Monthly precipitation (mm) and Perennial averages for Banja Luka and Sarajevo

Month			I	II	III	IV	V	VI	VII
Banja Luka	2016.	Temperature (°C)	2.3	7.6	8.0	13.5	16.2	21.5	23.3
		Precipitation (mm)	109.7	108.5	122.2	0.5	100.6	117.8	125.9
	Average 1981-2010	Temperature (°C)	0.6	2.3	6.8	11.5	16.5	19.8	21.8
		Precipitation (mm)	69.7	59.1	87.5	84.3	89.4	112.4	81.4
Sarajevo	2016.	Temperature (°C)	1.2	7.4	7.1	12.9	13.9	19.5	21.1
		Precipitation (mm)	46.6	87	131.7	60.5	82.1	96.4	104.5
	Average 1961-1990	Temperature (°C)	-0.8	1.7	5.5	10	14.8	17.7	19.7
		Precipitation (mm)	74	63	73	76	85	94	83

The land on which the trials were performed in Banja Luka is of good physical characteristics with a depth of the plowed land up to 35 cm. According to agrochemical analysis done at the Faculty of Agriculture in East Sarajevo, plowed land contains 0.13% nitrogen, 8.6% calcium, 2.05% humus, 4040 mg / 100 g phosphorus and 38.48 mg / 100 g potassium. The soil reaction is neutral, the pH in nKCl is 6.97, while the experiment field of the Faculty of Agriculture in East Sarajevo contains 0.27% nitrogen, 4.12% humus, 4040 mg / 100 g phosphorus and 36.41 mg / 100 g potassium. The soil reaction is slightly acidic, the pH in nKCl is 6.39.

## RESULTS AND DISCUSSION

The average yield of green mass was 29.7t ha<sup>-1</sup> (Table 2). According to *Mišković* (1986) yields of green mass in pure crop per hectare is in the range 25-35 t, while in the mixture with cereals is up to 50 t. *Hoffman and Dér* (2003) found green mass yield of 29,68 and 33,03 t ha<sup>-1</sup> in two pea genotypes, which is in accordance with our results.

The highest yield of green matter was recorded by variety Saša from Banja Luka (34,19 t ha<sup>-1</sup>) and it was significantly higher compared to the other tested variety, NS Junior (25,15 t ha<sup>-1</sup>). In control variant the yield of the green mass was 24.4t ha<sup>-1</sup>. In case where basic fertilization was applied, the yield was 32.3 t ha<sup>-1</sup>, and in case of basic fertilization +addition, it was 32.4 t ha<sup>-1</sup>. Mineral

fertilization had a significant influence on the yield of green matter compared to the control variant. In the variant basic fertilization + addition, yield of green mass was lower comparing to variant with only basic fertilization. The location did not have influence on the yield of green mass and it was in the ranged from 29.2 t ha<sup>-1</sup> to 30.1 t ha<sup>-1</sup>.

**Table 2.** Yield of green mass (t ha<sup>-1</sup>) / for forage

NPK quantity	Variety	Site		Average
		East Sarajevo	Banja Luka	
Control	NS Junior	17.4	21.5	19.5
	Saša	33.7	24.7	29.2
	Average	25.6	23.1	24.4
Basic fertilization	NS Junior	29.7	27.2	28.5
	Saša	37.0	35.2	36.1
	Average	33.3	31.2	32.3
Basic fertilization + supplementation	NS Junior	29.6	25.4	27.5
	Saša	33.4	41.0	37.2
	Average	31.5	33.2	32.4
Average	NS Junior	25.6	24.7	25.2
	Saša	34.7	33.7	34.2
Total average		30.1	29.2	29.7
Treatments		F-test	LSD 0,05	LSD 0,01
A (variety)		0.002	5.37	7.22
B (fertilization)		0.027	6.58	8.84
C (location)		0.727	5.37	7.22
AxB (variety x fertilization)		0.933	9.30	12.50
AxC (variety x location)		0.974	7.60	10.21
BxC (fertilization x location)		0.770	9.30	12.50
AxBxC (variety x fertilization x location)		0.173	13.16	17.68

The average yield of hay was 7.50 t ha<sup>-1</sup> (Table 3). The highest yield of hay was recorded on Sasa varieties (8.61 t ha<sup>-1</sup>), and it was significantly higher than NS Junior (6.39 t ha<sup>-1</sup>). This location had significant influence on the yield of hay and it was in the ranged from 7.75 t ha<sup>-1</sup> in East Sarajevo to 7.25 t ha<sup>-1</sup> in Banja Luka. In the control variant, the yield of hay was 6.24 t ha<sup>-1</sup>. In the variant basic fertilization, the yield was 8.18 t ha<sup>-1</sup>, while in the variant basic fertilization + addition, was 8.09 t ha<sup>-1</sup>. Comparing to control variant, application of different types of fertilization, had statistically significant influence to the increase of yield of hay.

*Mihailović and Mišković* (1988) obtained in their experiments the hay yield of 4.7-6.7 t ha<sup>-1</sup>, while experiments of *Henneberg et al.* (1989) during three year trial found that hay yield depended on genotype and ranged from 1.82 to 9.80 t ha<sup>-1</sup>. Three year experiments of *Tekeli and Ates* (2003) showed average hay

yields in five pea lines of 3.44-7.38 t ha<sup>-1</sup>. Similar results were obtained by Ayaz *et al.* (2004). Our results are in accordance with the results of the quoted authors.

**Table 3.** Hay yield (t ha<sup>-1</sup>) / for forage

NPK quantity	Variety	Site		Average
		East Sarajevo	Banja Luka	
Control	NS Junior	4.46	5.52	4.99
	Saša	8.65	6.34	7.49
	Average	6.55	5.93	6.24
Basic fertilization	NS Junior	7.62	6.58	7.10
	Saša	9.49	9.03	9.26
	Average	8.55	7.81	8.18
Basic fertilization +supplementation	NS Junior	7.59	6.60	7.09
	Saša	8.68	9.51	9.09
	Average	8.14	8.05	8.09
Average	NS Junior	6.56	6.22	6.39
	Saša	8.94	8.28	8.61
Total average		7.75	7.25	7.50
Treatments		F-test	LSD 0,05	LSD 0,01
A (variety)		<.001	0.2011	0.2702
B (fertilization)		<.001	0.2464	0.3310
C (location)		<.001	0.2011	0.2702
AxB (variety x fertilization)		0.210	0.3484	0.4681
AxC (variety x location)		0.281	0.2845	0.3822
BxC (fertilization x location)		0.032	0.3484	0.4681
AxBxC (variety x fertilization x location)		0.791	0.4927	0.6619

## CONCLUSIONS

Based on the obtained results, the following can be concluded:

- The highest yield of green mass had the variety Saša, while the lowest had variety NS Junior. The largest yields of hay had the varieties NS Junior and Saša, while the lowest had variety NS Junior.

-In the control variant, was recorded the smallest yields of green mass and hay. In the variant basic fertilization with NPK was recorded the best results. Thus, basic fertilization+ addition had poorer results compared to basic fertilization, in order to reduce pollution and save the environment, this measure can be omitted.

-Ecological conditions have influence on the yield of hay, while they have not affected the yield of green matter. In agro-ecological conditions in East Sarajevo, the yield of hay was significantly higher compared to the tested characteristic in the agro-ecological conditions of Banja Luka.

**REFERENCES**

- Ayaz S., McKenzie B.A., Hill G.D., McNeil D.L. (2004): Variability in yield of four grain legume species in a subhumid temperate environment. I. Yields and harvest index. *Journal of Agricultural Science*. 142: 9-19.
- Brkic S. (2002): Efficiency of bacterization, fertilization of tobacco and molybdenum on the nature of the cattleman. The dissertation. Faculty of Agriculture in Osijek
- Duthion C., Pigeaire A. (1991): Seed lengths corresponding to the final stage in seed abortion of three grain legumes. *Crop Science* 31, 1579-1583.
- Erić P., Čupina B., Mihailović V., Mikić A. (2007): One-year old fodder legumes. Scientific Institute of Field and Vegetable Crops, Novi Sad, monograph, 256 pages.
- Gatarić Đ., Milanka Drinić, Radić V., Kralj A. (2014): Manufacture on oranicams and nutrition value feedin plants. Faculty of Agriculture, East Sarajevo
- Henneberg R., Kolak I., Štafa Z. (1989). «Maksimirski bijeli», A new cultivator of the frozen fodder. *Agronomic messenger*. 1-2: 21-37.
- Hoffman F., Dér F. (2003). Yield of different green forage crops, in pure stand and in mixture. *Agriculturae Conspectus Scientificus*. 68 (4): 275-279.
- Kovac K. (1994): The effect of some intensification factors on the pea yield of intermediary type in maize-growing region (Czech). *Rostlinna Vyroba* 40(10), 949-956.
- Mihailoviš V., Mińkoviš B. (1988). The results of the selection of grape harvesters. *Proceedings of the XXII Agronomy Seminar, Neum*: 320-324.
- Miskovic B. (1986): Fodder herbs, IRO "Scientific Paper", Belgrade.
- Popović S., Stjepanović M., Grljušić S., Čupić T., Tucak M., Bukvić G. (2002): Yield and quality of the grain of the grain pear. *Fodder* 44 (4), 191-197.
- Rapčan Irena, Bukvić Gordana, Grljušić Sonja, Teklić Tihana, Jurišić M. (2006): The influence of agroecological cobditions and seed maturity on the grain yield and quality of field pea (*Pisum sativum L.*). *Mljekarstvo* 56 (4) 331-342.
- Rapčan Irena, Jurišić M., Grljušić Sonja (2004): Reponse of pea (*Pisum sativum spp. Arvense L.*) at sowing term, stand and nitrogen fertilization at area of Osijek. *Agronomski glasnik*, 33-45.
- Tekeli A.S., Ates E. (2003). Yield and its components in field pea (*Pisum arvense L.*) lines. *Journal of Central European Agriculture*. 4 (4): 313-317.